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Teaching Tasks in an Adaptive Learning Environment

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1 Introduction

The WWW (World Wide Web) has been the best technology for distributing information since it was born. It has been used for teaching and learning (Llamas et.al. 1996) (Vassileva 1997), but the learning process is more complex than navigating between different static pages and reading them. There is a need for mechanisms that modify the navigation alternatives by some sort of adaptation, so that the students can be guided to achieve their learning goals.

Not all students have the same skills for learning a concrete subject. Some of them need more explanations than others, and they may have previous knowledge about the subject or not. There are other differences among students related to personal features such as age, interests, preferences, etc. which are important too (Nill 1997). Moreover, the results of each student's work during the learning session must be taken into account in order to adapt the next contents to the student (Brusilovsky & Anderson 1998).

One of the most interesting techniques intended to incorporate adaptability to hypermedia courses is the technique of sensitive links (Brusilovsky et al. 1996). By this technique, links between hyperdocuments can depend on the state of the learning session, including both the availability of the link and its contents.

This paper describes an alternative approach to the construction of tutoring systems to be deployed through Internet, that has the main advantages of sensitive links, and can be extended to more general settings than hypermedia courses. Our approach is based on the use of Teaching Tasks in order to guide the student towards the desired goals during the learning process. Student profiles and actions, as well as different teaching strategies, are taken into account to decide the next set of achievable tasks. As a consequence, students are not obliged to follow a linear sequence of actions, and courses are

dynamically adapted to each student. This is the approach followed in the InterEdu (Internet in Education) project (Alfonseca et al. 1998).

2 Teaching Tasks

A Teaching Task (TT) is the basic unit in the learning process. TT descriptions include the following general attributes: *name*, *content* and *composition type*, and *ending requirements*. *Content type* distinguishes between theoretical, practical and example tasks. According to the *composition type*, tasks may be atomic or composed. Finally, *ending requirements* are implemented by means of functions which decide, at runtime, whether tasks have been completed. This decision is based on parameters directly related to student actions, in the case of atomic tasks, or on subtask finalization, if the task is composed. TTs can also have specific attributes, such as those used for HTML page generation and others related to the exercises associated to practical tasks. All these static attributes constitute the TT model, as stored in the **Teaching Task Repository**.

At execution time, information about the sequence of tasks performed or just initiated by the students is stored in her/his **dynamic workspace** as dynamic trees. This information is enriched by the addition of dynamic attributes related to student actions on specific tasks, such as the time (s)he has spent learning a task, the number of pages visited and, in the case of practical tasks, the rate of exercises successfully done by the student. Finally, we also store the grade of learning achieved on a concrete task, calculated by means of a function that makes use of those dynamic parameters.

The components of the system are illustrated in figure 1, where dotted arrows represent information flow, solid ones represent inter-process communication and the white arrow represents a function call.

The **Task Manager** receives information about student events via the **Process Manager**, and decides the next set of achievable tasks depending on the active learning strategy, the model in the teaching task repository, the student personal data in the **Student Data Repository**, and the contents of the dynamic workspace.

Once the next task is identified, the Task Manager sends relevant information to the **Page Generator** about the page(s) to be built, so that the contents of the pages will depend on dynamic data related to the student. Concrete multimedia elements are selected just before generating the page(s), depending on the student profile, and may be texts, graphics, videos, applets and animations, including simulations (Hyötyniemi & Nissinen 1998).

More details about the functioning of the system can be found in (Carro et al. 1999).

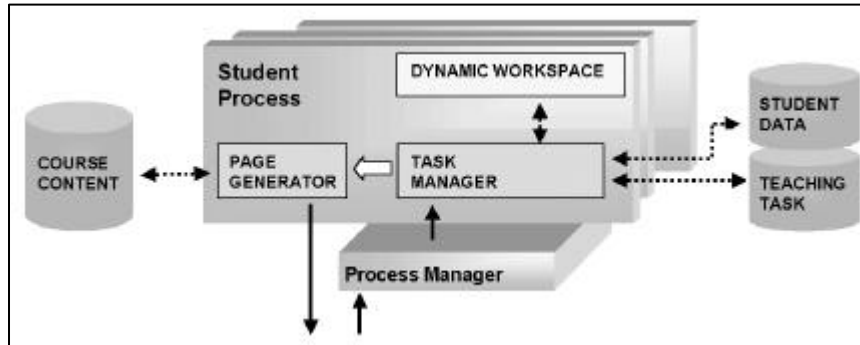


Figure 1: System components

3 Huey, Dewey and Louie learn how to drive

The first application developed using this approach is a course on driving. In figure 2 some of the tasks that belong to the module on traffic signs are shown. Each row in the table describes a composed task, including: (1) the list of associated subtasks, (2) the subtask sequencing: OR means that only one of the subtasks has to be performed, AND means that they all have to be performed in the prescribed order, and ANY means that they have to be performed, but in any order, (3) a precondition to be satisfied for initiating the task.

TASK	SUBTASKS	SEQUENCE	PRECONDITION
traffic-signs	types, priority	ANY	student-age < 18
traffic-signs	types, prio-theory	ANY	student-age > 18
types	agents,semaphores,vertical-signs, marks, circumstantial-signs	ANY	
agents	agtheory, agpractise	AND	
vertical-signs	vshape, vmeaning	OR	
vshape	vstheory, vspractise	AND	student-age > 18
vshape	vstheory, vxexamples,vspractise	AND	student-age < 18
vmeaning	vmtheory, vmpractise	AND	student-age > 18
vmeaning	vmtheory, vmexamples, vmpractise	AND	student-age < 18
vstheory	circular-signs, squared-signs	ANY	
circumstantial-signs	ctheory, cpractise	AND	exer-ok in task vertical-signs > 3
priority	prio-theory, prio-example	AND	

Figure 2: Sample task decomposition

ANY and OR sequencing allow different students to achieve teaching tasks in different ways. In our example, a student may decide to study vertical signs according to their meaning, whereas another may prefer a classification according to their shape. In a similar way, although all students must achieve the subtasks corresponding to the 'types' task decomposition, each of them can achieve these subtasks in a different order. Not only the choices made by the students determine the way in which they will learn about a specific topic, but also the learning strategy that is being applied in a specific moment, the student profile (e.g. his/her age), and even previous student actions. This is specified as precondition in figure 2.

As mentioned above, all the information about the way in which each student has achieved different tasks is stored in the student dynamic workspace. Figure 3 shows the workspaces of three different students: Huey, Louie and Dewey. All of them have started by learning about vertical signs. However, whereas Huey and Louie have preferred to study them by their shape, Dewey has chosen to do it by their meaning. Huey will start with the theory about the shape of vertical signs, given that he is following a theory-first learning strategy, whereas Louie will start with the practice, as determined by the practice-first learning strategy. Notice that the three of them will be presented with theory and practice about vertical signs, but Louie, in addition, will see examples about the subject, because he is younger than eighteen and, consequently, less experienced than the others from the point of view of the course designer.

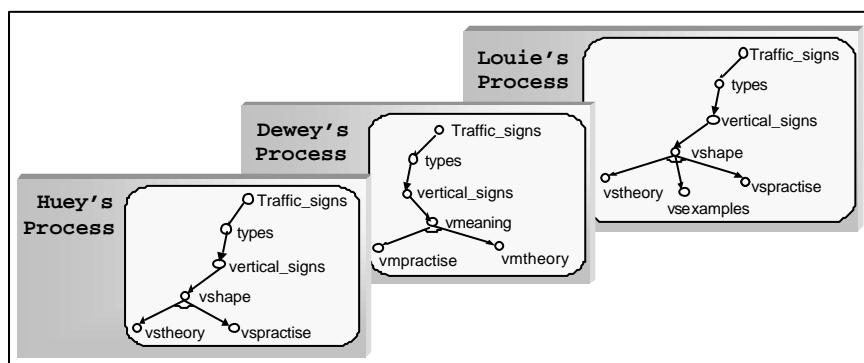


Figure 3: Three dynamic workspaces for the same composed task

4 Conclusions

The mechanism of teaching tasks presented in this paper adds adaptability to interactive courses, by controlling events about the keystones reached by

students at different stages of their learning process. The description of the course referred to in this paper, including the specification of teaching tasks and rules, can be found at <http://www.ii.uam.es/~rcarro/Webnet99/TaskTree.html>.

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